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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference FPAA240PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/N 03/00278	International filing date (day/month/year) 22.08.2003	Priority date (day/month/year) 29.08.2002
International Patent Classification (IPC) or both national classification and IPC C01G37/02		
Applicant TATA INSTITUTE OF FUNDAMENTAL RESEARCH et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 8 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 27.03.2004	Date of completion of this report 10.12.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Besana, S Telephone No. +49 89 2399-8002 

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I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

Description, Pages

1-3, 5-7, 9-23
4, 8

as originally filed
received on 30.08.2004 with letter of 25.08.2004

Claims, Numbers

11-39
1-10

as originally filed
received on 30.08.2004 with letter of 25.08.2004

Drawings, Sheets

1/19-19/19

as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
- (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

see separate sheet

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:

- ☐ restricted the claims.
- ☒ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.
- ☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.
- ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	2-4
	No: Claims	1,5,9,16,23-39
Inventive step (IS)	Yes: Claims	2-4
	No: Claims	6-39
Industrial applicability (IA)	Yes: Claims	1-39
	No: Claims	

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2. Citations and explanations

see separate sheet

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Re Item I

Basis of the report

The amendments filed with the letter dated 25.08.2004 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following:

1. Claim 1 has been amended in that the value for the saturation magnetisation for pure chromium dioxide is at least 115 emu/g.

This feature has been added also in the description on page 8 lines 6 and 24. However, no basis could be found in the application documents for substantially pure chromium dioxide having saturation magnetisation of at least 115 emu/g.

2. The statement "It is thus noted that for bulk polycrystalline CrO_2 , the value of saturation magnetisation more than 110 emu/g has not been reported earlier" was added on page 4 of the description.

However, no basis could be found in the application documents as originally filed for this statement.

Hence, this report is established as if these amendments had not been made.

Re Item IV

Lack of unity of invention

This Authority considers that there are three inventions covered by the claims indicated as follows:

1. Claims 1-8, 25-35, 37

Chromium dioxide having saturation magnetisation of at least 115 emu/g and the process for manufacture pure chromium dioxide comprising heating an intermediate oxide to a temperature between 390 and 400 °C for a period of 1 to 5 hours.

2. Claims 9-15, 21-36, 38

Composite of chromium dioxide and chromium sesquioxide having negative magnetoresistance of at least 0.5% near room temperature at 2 Tesla and the process for manufacture the composite of chromium dioxide and chromium sesquioxide comprising heating an intermediate oxide to a temperature between 450 and 500 °C for a period of 1 to 5 hours.

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3. Claims 16-36, 39

Composite of chromium dioxide and Cr_2O_5 having negative magnetoresistance of at least 0.5% near room temperature at 2 Tesla and the process for manufacture the composite of chromium dioxide and Cr_2O_5 comprising heating an intermediate oxide to a temperature between 350 and 390 °C for a period of 1 to 5 hours.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The concept linking together independent claims 1, 9 and 16 is the presence of CrO_2 , however, chromium dioxide is a well known half-metallic compound used for magnetic recording and having unique magnetic properties (see the prior art documents cited in the application).

Claim 25 defines a process wherein by varying the heating temperature is possible to obtain three different products.

In this case the process itself cannot be the inventive linking concept between the three groups of inventions as several methods are disclosed in Table 1 of the present application in which CrO_3 , i.e. the precursor for the intermediate oxide defined in claim 25, is heat treated in the defined range of temperatures, 350-500°C, for a period of 1 to 5 hours in order to obtain CrO_2 or a $\text{CrO}_2/\text{Cr}_2\text{O}_3$ composite.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document/s/:

- D1: JIANBIAO DAI AND JINKE TANG: "Junction-like magnetoresistance of intergranular tunneling in field-aligned chromium dioxide powders" PHYSICAL REVIEW B, vol. 63, no. 054434, - 12 January 2001 (2001-01-12) pages 1-4, XP002267622
- D2: GB-A-1 274 880 (RCA CORPORATION) 17 May 1972 (1972-05-17)
- D3: L. RANNO ET AL.: "Production and magnetotransport properties of CrO_2 films" J. APPL. PHYS., vol. 81, no. 8, 15 April 1997 (1997-04-15), pages 5774-5776, XP002278997
- D4: US-A-3 117 093 (ARTHUR JR PAUL ET AL) 7 January 1964 (1964-01-07)
- D5: GB-A-1 343 622 (MONTEDISON SPA) 16 January 1974 (1974-01-16)

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D6: US-A-3 979 310 (ASPES PIERFRANCESCO ET AL) 7 September 1976 (1976-09-07)

2. The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 5, 9, 16, 23-39 is not new in the sense of Article 33(2) PCT.

The document D1 (cf. p.1 "Experiments"; p.2 "Results and Discussion" left-hand column) discloses polycrystalline CrO_2 having saturation magnetisation of 110 emu/g. Hence, D1 is novelty destroying for the subject-matter of claims 1 and 5.

The document D2 (cf. p.1 l.44-p.2 l.35; ex.I,IV) describes a process for manufacturing a composite $\text{CrO}_2/\text{Cr}_2\text{O}_3$ wherein chromium trioxide is heated in air thus forming CrO_2 . When the temperature exceed 360°C the ferromagnetic chromium dioxide is diluted with non-magnetic Cr_2O_3 . Hence, D2 is novelty destroying for the subject-matter of claims 9, 23, 25, 27, 29-32, 34-35, 37 and 38.

The documents D3 (cf. p.5774 "Synthesis"), D4 (cf. col.2 l.48-61; examples) and D5 (see the examples) all describe manufacturing processes for $\text{CrO}_2/\text{Cr}_2\text{O}_3$ or $\text{CrO}_2/\text{Cr}_2\text{O}_5$ by heat treatment of CrO_3 under different conditions. D3 is therefore novelty destroying for the subject-matter of claims 9, 16, 23, 25-27, 29-32, 36-39, D4 is relevant for claims 16, 23, 25, 27, 33-35, 37 and 39 and D5 for claims 25, 26, 29, 32, 33 and 37.

3. In his letter dated 25.08.2004 the applicant stated that cited prior art does not teach the preparation process for substantially pure CrO_2 and its composites wherein CrO_3 is taken as the starting material, which is heated to form the intermediate Cr_8O_{21} from which CrO_2 and its composites are formed by temperature modulations. Furthermore the applicant argued that unlike the prior art no modifier is used, pressure is not a control limiting parameter and the starting material and the intermediate product are different.

This argument cannot be accepted as in independent claim 25 there is no definition of the starting material being CrO_3 or the intermediate being Cr_8O_{21} . Moreover, in the claimed process the use of modifiers is not excluded and pressure parameters remain undefined. Hence, the known processes fall within the definition of claim 25.

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4. Dependent claims 6-8, 10-15 and 17-22 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step in that the applicant has demonstrated no surprising technical effect for the additional feature.

5. The combination of the features of dependent claims 2-4 is neither known from, nor rendered obvious by, the available prior art.